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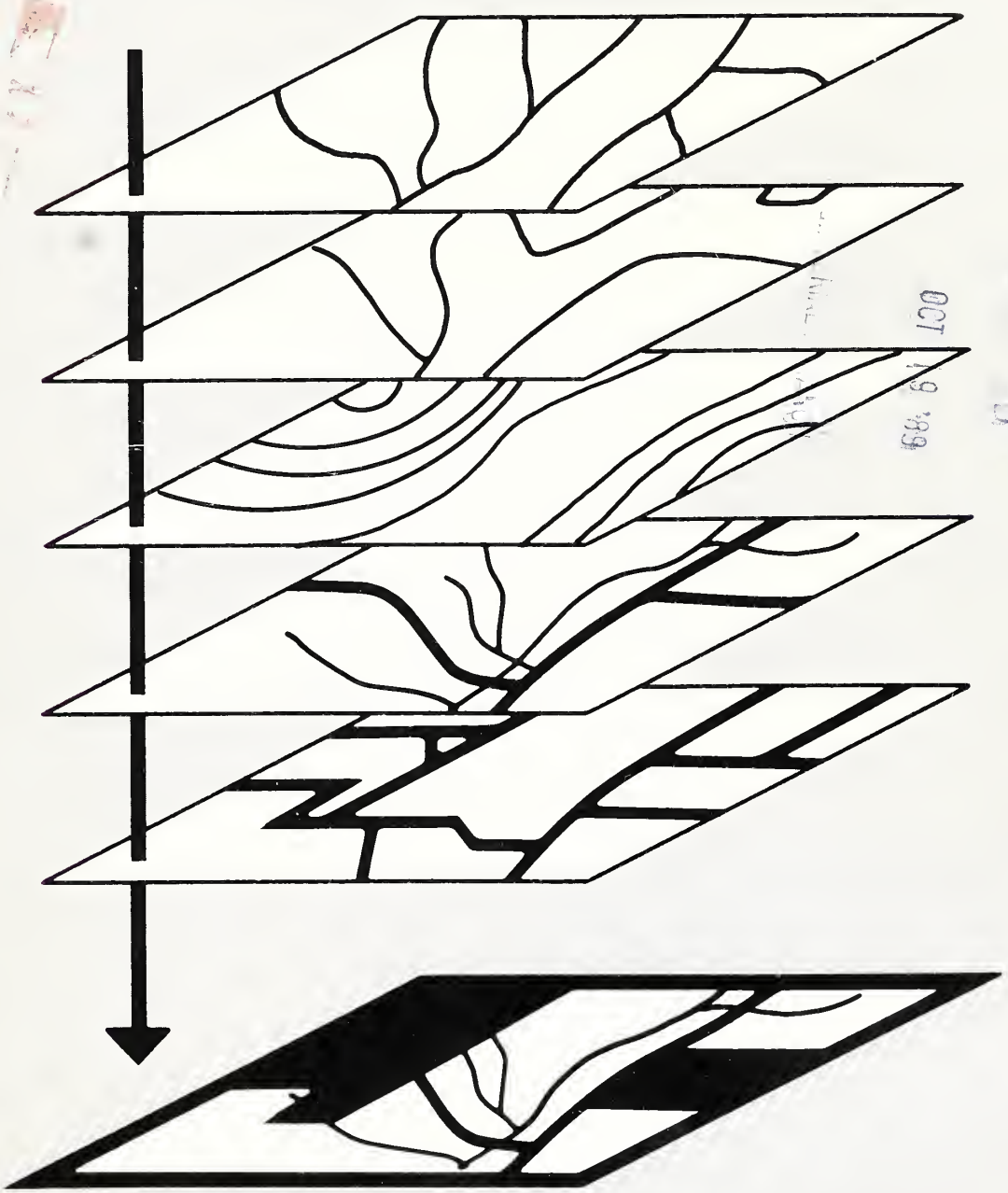

NEW TECHNOLOGY

Cover:
The Geographic Information System (GIS) produces interpretive maps depicting highly erodible cropland areas. (See detailed diagram on page 10.)

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Comments from the SCS Chief:

SCS Looks Ahead

The Soil Conservation Service is one of the world's top technical service agencies. Its professional outreach — its technology transfer — is global. And its obligation to the conservation profession is to be on the frontier of applied technology.

This Nation and the world we serve are changing rapidly. If we want to have the best resource information in hand and the best resource conservation on the ground, we have to be in tune with research, with the needs of our clientele and staff, and with changes in the world around us.

Most of all, we have to stretch our imaginations and envision how we're going to have the best science and technology at our fingertips in decades to come.

Inside this issue you'll see a preview of the technological changes that are right around the corner. The year 2001 is a little more than a short decade away, closer than we realize. It will bring exciting new possibilities.

Many of the innovations that you'll read about on the following pages are a direct response to requests and suggestions from the field. Those of you out there on the spot told us what you needed to do your jobs, and we set about finding the most efficient, most accurate, most up-to-date means of supporting you.

Change can be a little frightening, but it is a certainty. We need to be ready to meet it, harness it, and put it to work. For those of us who have been out of school for a number of years, it may mean taking some courses, attending seminars, or getting specialized training on or off the job.

To stay a leader in conservation, SCS must stay on the cutting edge of technology.

NEW TECHNOLOGY

SCS in the 21st Century

IN A LITTLE MORE than a decade, SCS will enter the 21st century. An extraordinary number of forces — national and global, technical and social — will dictate the nature of our agricultural clientele, their needs, and our technology.

We'll need better ways to —

- Appraise and map our natural resources,
- Use the vast data we have accumulated to give our field people better access, our clientele better service, and
- Develop conservation practices and systems that will help us protect those resources.

Environmental issues increasingly will become part of the U.S. agricultural scene. Environmental and consumer interest groups will continue to push for safe, nutritious food and for an environmentally clean and responsible agriculture. Mounting public pressure may bring about stiff regulation on agriculture to solve erosion, water quality, and other environmental problems. Reduced use of chemicals will become the norm rather than the exception. The desire for contaminant-free produce will become an overriding factor in consumer selection.

The United States will have a better understanding of long-term global environmental problems and will have eliminated some from concern, finding they do not constitute major threats.

Efforts to keep the Federal budget in balance will continue to drive cost-cutting schemes and encourage efficiency through technology.

Breakthroughs in biotechnology and genetic engineering will change the way farmers farm and the ways in which SCS deals with resource problems. Biogenetics as an applied science will become a controlling force in agriculture of the next decade. Our plant materials program, for one, could benefit greatly. However, the biogenetics sword is two-edged, and just as the chemical boom brought many new "improvements" to living and harmful effects to the environment, biogenetics brings many new opportunities and potential dangers.

In genetic engineering, developments in a number of areas will have far-reaching effects:

- Perennial corn will make permanent corn rotations possible in certain areas of the country;
- The ability of nonleguminous species to fix nitrogen in root tissue will lessen the need for nitrogen fertilizer;
- Increased resistance to a host of different crop and plant pests will decrease the need for chemical pesticides; and
- Soybeans that contain a complete amino acid complement will be more desirable as a protein source for the world's population, and could increase world demand for our beans.

Advances in superconductor technology could revolutionize our thinking. Certainly, we would see a technological revolution at least on a par with that following the application of silicon chip technology.

We already have a trend toward either large farms or small-scale operations, with fewer in the medium-size range. Our clientele will continue to diversify to include more part-time farmers, minority farmers, limited resource farmers, institutional owners, renters, and others.

The outlook is for fewer full-time farmers than there are today, perhaps a third fewer. Those who remain in agriculture generally will be better educated and will be running technologically sophisticated operations. Computers will be as commonplace as

Satellite images are applied to computer-generated maps that outline crop "histories" and soil and climate conditions. These combined displays enable USDA statistician Lyle Lautenschlager to develop new mathematical procedures using Landsat imagery for predicting crop yields. (Photo courtesy ARS.)

By **Robert R. Shaw,** deputy chief for technology, Soil Conservation Service, Washington, D.C.

An extraordinary number of forces — national and global, technical and social — will dictate the nature of our agricultural clientele, their needs, and our technology.

tractors and will enable the operator to link up to USDA daily.

As the number of full-time farmers declines, individual landowners producing crops in small amounts for their own use or for sale may increase. If energy costs are high, thus discouraging transportation of high-value crops, part-time farmers or those with smaller tracts may develop their land for specialty crop production. Vegetables, fruits, spices, and herbs are among those items which could receive local attention.

In light of an expected shortage in college-trained specialists, SCS will need to be prepared to provide training and close supervision of technician positions at the field level.

High-tech operations will help the staff work more efficiently, leaving more time for interdisciplinary training.

To meet the next century, SCS has to tackle the following:

- Place high priority on technology development and technology transfer.
- Develop practical models and data bases that can help landowners better predict the economic and environmental effects of their actions on the land.
- Ensure multidisciplinary training for field staff.
- Work closely with a broader range of organizations to establish a consensus in technical standards.
- Deal with potential workforce shortages.
- Continually enhance our reputation as the world's leading experts in soil, water, and related resource management.

The Field Office Leader Of the 21st Century

WHAT WILL A DAY in the life of a field office leader be like in the next century?

As SCS officials envision it, the typical field leader in the 21st Century:

- is an 8-year SCS veteran.
- monitors electronic mail and office schedules on a microcomputer.
- uses a portable data recorder when visiting a new cooperator to discuss conservation planning. Within minutes, the cooperator receives a list of alternative practices suited to onsite needs.
- meets with local civic and business leaders, landowners, farm managers, and representatives from other government agencies to discuss resource potential and limitations in a local watershed. Geographic Information System (GIS) analysis provides the group with management options and impact analyses.
- taps State data files to provide site-specific resource data for a farmer with a microcomputer. The farmer's software package analyzes the SCS data on weather, topography, geology, soils, economic factors, and conservation practice standards.
- sends out a resource conservationist to collect ground-truth data for the National Resources Inventory. The SCS vehicle's navigation system and portable satellite global-positioning system find the preselected NRI data points quickly.
- monitors the latest SNOTEL data with a desktop computer.
- reads science and technology reports and abstracts transmitted by computer.
- links videoteleconference equipment in the office with the State and area office and National Technical Center specialists.
- receives a weekly cumulative summary of field office accomplishments, equipment needs, cooperator contacts, and other management data from Computer Assisted Management and Planning System (CAMPS) equipment.

Soil work will be oriented to natural resource areas, instead of political boundaries such as States.

High-tech detective work is also being done through infrared aerial photography. USDA entomologist Kenneth R. Summy can easily identify and find (see photo at right) unplowed or regrowth cotton that, by Texas law, needs to be destroyed to curtail the boll weevil and reduce the application of pesticides. The aerial photography also tracks how well farmers have plowed their fields at a cost of only about half-a-cent per acre. (Photos courtesy ARS.)

Conservation Toolkit for The Next Century

THE SCS FIELD OFFICE in the next century is going to have a remarkable array of tools to meet the needs of its clientele.

Information Technology in the Workplace — The microcomputer has simulated for nearly all the technological headway made in the past decade, and its importance can only grow in the future.

By 2001 (in fact, by 1995), every SCS office should have its complement of Field Office Communications and Automation System (FOCAS) equipment. Thanks to the Computer Assisted Management and Planning System (CAMPS) software, clerical and administrative tasks will be streamlined and automated. CAMPS, linked with the Geographic Information System (GIS), will support flexible conservation planning concepts using system approaches, artificial intelligence, and sophisticated modeling and application programs.

The field office technical guide will evolve into an expert system. Parts of the field office technical guide will be stored in the computer as a data base. Analytical models such as Chemicals, Runoff, and Erosion from Agricultural Management Systems (CREAMS), Drainage Model (DRAINMOD), and Water Erosion Prediction Project (WEPP) will be in the computer. As a result, before selecting a resource management plan, the landuser will have a thorough understanding of the monetary and nonmonetary costs ben-

. . . SCS will have worked with technical and professional societies and conservation agencies and groups to establish consensus technical standards and procedures for engineering systems.

efits of the system and how it will appear on the landscape.

Resource Inventories — By 2001, much of the National Resources Inventory data will be collected using high-resolution, remote-sensing technology coupled with computerized linkages with other digital data bases.

Instead of performing one resource inventory, the resource inventory field offices will be involved primarily in providing ground-truth data used to train computers to recognize features such as ground cover, degree of erosion, and wetness based on reflectance from high-resolution satellite images. Field office staff may be able to locate preselected data points while traveling in vehicles equipped with navigation systems that display vehicle and point location on a map.

Geographic Information System — Software will instantaneously access SCS, the U.S. Geologic Survey, and other national and local data files to produce a "topoquad" base map of topography, hydrography, soils, geology, cultural resources, and transportation, as well as ownership boundaries and land use information. The viewer will see the map data on monitors and may call up, by voice command, thematic overlays of soil interpretations and displays of potential uses.

GIS will be able to display inventory results graphically. Families of resource maps will be produced that can be computer-manipulated and interpreted for various planning purposes.

Snow Surveys and Water Supply Forecasting — Use of the radio telemetry SNOTEL system will increase significantly in collecting information on the mountain snowpack. Exploring the use of radio telemetry will also be extended to other data collection efforts, such as determining soil moisture on a real-time basis. Further enhancements of the Central Forecasting System and the automated report generation of the State's Water Supply Outlook reports will increase usefulness of the overall system.

Soil Surveys — By 2001, SCS soils data files and digitized maps will be widely used by State agencies, private consultants, universities, foundations, and individuals.

Users will expect soils information to be as readily available as the U.S. Geological Survey's 7½-minute topographic quadrangles, at the same or similar scales and with the same standards of accuracy. All soil survey updates will be made on scale-accurate orthophotoquads.

Federal leadership in soil science will be evident. The basic philosophy of soils will be rethought and rejustified. Models of soil development will be commonplace.

Soil work will be oriented to natural resource areas, instead of political boundaries such as States. New formats of data presentation, files, and interpretations will be commonplace.

Conservation Planning — Portable SCS computers centers or the landowner's own computer will expedite planning in 2001. Specialized software, data bases containing meteorological, topographic, soils, and geologic data — as well as SCS criteria and economic information — will support analytical models, imagery, and final design of practices and systems.

SCS analytical models such as the Ephemeral Gully Erosion Model (EGEE) and the Water Erosion Prediction Project (WEPP) will compute the effects of various management alternatives on erosion, water management, waste management, water quality, yields, and profits. They will be displayed in a three-dimensional, color image on the farmer's computer monitor. Monetary and nonmonetary estimates of costs, benefits, and risks will be displayed for each management alternative. After planning decisions are made, the farmer will receive a printout of the final designs, construction drawings and specifications, operation and maintenance plans, and other documentation.

One major advantage of automated conservation planning is the speed with which it can react to changes in policy and technical standards. For example, if strong ground water protection legislation were passed, field offices could immediately screen conservation plans for "problem areas." Another example might be a determination of the effect of a change in the practice factor on conservation compliance.

A potential advantage of automation is that it will free-up the field office leader to do more noncomputer activities.

SCS' Role — By 2001, SCS will have worked with technical and professional societies and conservation agencies and groups to establish consensus technical standards and procedures for engineering systems.

In addition, the development of a sophisticated toolkit will be all the more important to SCS in light of an expected shortage in college-trained specialists.

[The] recommendations will greatly improve the budgeting process for inventories, streamline the inventory effort, and reduce the burden on field personnel.

Streamlining The NRI

QUESTIONS ABOUND: How can those working in natural resource areas actually tell whether they are managing the forests well? How is it possible to determine whether erosion is lessening or worsening? What, specifically, is happening to nonfederal land?

Answers to these and other resource-related questions can be found in the charts, maps, and graphs generated by the National Resources Inventory (NRI), begun by the Soil Conservation Service in 1977. The purpose of the NRI is: to collect, interpret, and distribute data to identify natural resources status, condition, and trends on all nonfederal lands nationwide; to explore potential programs to address resource problems; to evaluate existing program performance; and to allocate financial resources and determine personnel needs.

By law, the NRI must be done every 5 years. In March 1988, a work group was formed under the leadership of Philip H. Christensen, State conservationist in Storrs, Conn., to explore ways to streamline the NRI process. The study was an attempt to reduce the impact on other SCS work and promote continuous funding while collecting and disseminating the best possible information.

Equipment and materials are constantly being developed that will significantly reduce cost and staff time spent collecting data. While there are still many unanswered questions about how quickly advancements in technology will simplify the inventory process, one thing was clear to the work group studying the techniques used for conducting the NRI: it needed streamlining.

The work group made four major recommendations which they felt were practical and realistic for improving the NRI process for the near term — 1992 and 1997. These recommendations will greatly improve the budgeting process for inventories, streamline the inventory effort, and reduce the burden on field personnel. The implementation of these recommendations will also move SCS forward in the evaluation and utilization of emerging technologies.

The first major recommendation was to improve the organization and coordination of the present inventory process. Minimizing the scope of the inventory items and increasing statistical significance requires an attentive evaluation of proposed data needs, as well as the commitment to keep the number of sample areas to a minimum. Toward this end, the work group recommended three actions:

- Establish a procedure for selecting inventory data elements as far in advance of data collection as possible;
- Accelerate joint inventory efforts with the Forest Service and other agencies compiling inventory data bases; and
- Develop procedures to allow quick dissemination of inventory results.

The second major recommendation was to accelerate the use of remote sensing and Geographic Information Systems (GIS) for NRI. Remote sensing is simply getting information about ground conditions without going there. It can take several forms — from visually interpreting aerial photographs to interpreting digital-image processing of satellite data by computer. Remote sensing has been used effectively to improve the efficiency of NRI data collection in several States. New technology, better photography, and effectively trained specialists will help to advance the use of remote sensing in the data collection process.

However, this technology has high initial equipment and materials costs and calls for well-trained technicians. Some field work will always be needed to calibrate and verify interpretations. But, because remote sensing has such a tremendous advantage over on-ground data collection in being able to collect for an entire area of interest and allows for computer interpretation, the cost effectiveness will be felt in the reduction of time and personnel required for data collection.

The work group recommended the following actions regarding remote sensing:

- Develop a strategy for the use of remote sensing (photography and satellite data) in all States for the 1992 NRI;
- Develop long-term plans for the use of remote sensing and GIS techniques in resources inventory work;
- Encourage States to test and develop applications of remote sensing and GIS techniques in resources inventory work; and
- Encourage training in remote sensing and related techniques for employees at all levels.

The third major recommendation was to establish a process to use teams in carrying out inventory activities. States would chose, train, and manage to suit needs, workloads, and capabilities. Each State conservationist would determine the team composition and duties. The team leader would be the Resources Inventory Specialist (RIS), and team members would be chosen for the specific needs of the inventory. While the team would consult and work with district conservationists, the field office wouldn't be responsible for the data

Some image processing packages can show how the practice will look tomorrow or how it will look in 5 years.

collection work. Personnel selected for the teams, if detailed or temporarily reassigned, would forego regular job responsibilities while doing inventory work to ensure that inventory work is done as a primary responsibility instead of an additional task.

The fourth major recommendation was to execute a continuous national inventory process, as opposed to a major push every 5 years. The goal is to provide for a high-quality resource inventory, a uniform inventory budget to implement the technology, and management recommendations as reported above. This continuous process would include gathering and preparing materials, building GIS data bases, training staff, gathering and analyzing data, and preparing reports on the present 5-year schedule. However, one of the recommendations the work group made was for the establishment of a 10-year schedule instead of a 5-year schedule, and a management strategy for executing a continuing inventory process.

A full report, "Streamlining the National Resources Inventory Process," released in March 1989, expands on the recommendations above and provides extensive background on the options considered and the rationale for each recommendation. This report is available through SCS/Resources Inventory Division and/or through each SCS State office and the National technical centers.

Kathleen Diehl, contributing editor, SCS, Washington, D.C.

Technology Is Down to Earth

THE OLD CLICHE "A picture is worth a thousand words" is getting a new twist in the Soil Conservation Service. The expression now being coined is "A picture is worth thousands of dollars."

Image processing is a new "down-to-earth" way to get pictures. Simply put, here's how it works: an SCS technician goes to a landowner's farm with a video camcorder and shoots footage of sites that have erosion problems. Back in the office the technician plugs the camcorder into a computer and the eroding site image appears instantly on a high resolution monitor. At this point, the technician uses the computer as a drafting board, and with Computer-Aided Drafting (CAD) software can manipulate the picture in any way. The pictured erosion problem can suddenly be replaced by an approved conservation practice. The technician can draw from a large data base library and a myriad of design elements such as trees, shrubs, groundcover, walls, fences, and much more to custom design the site. He or she can resize the design, rotate it, color it, and drop in text and numeric information to provide specific details such as elevation and slope.

Image processing is a combination of video and computer technology that customizes selected sites, conservation practices, individual measures, and construction details. The technology gives the landowners and SCS employees the ability to visualize the proposed design before installment of practices. Communication to reach a common understand is greatly enhanced. This can prevent major problems that might also involve major costs. Many options showing various renderings of the same scene can be obtained in minutes. Some image processing packages can show how the practice will look tomorrow or how it will look in 5 years.

"Many landowners don't know how to read our plans," Bob Snieckus, California State landscape architect said. "They can't visualize the finished product. However, with the CAD product, you show them an almost photo-quality rendering in a matter of minutes and it becomes incredibly clear, reduces confusion, and saves time and money for both SCS and the landowner."

An image processing system can benefit SCS planners and landowners in several ways: it can be used for visualizing conservation measures, for training new employees by illustrating conservation measures before they are installed, and for educational purposes in group meetings.

The system's major components are a computer, digital scanner, monitor, video camcorder, stylus, tablet, and attendant software. Many States have caught the CAD fever and are seeking ways to bring this technology into their own State offices. At present this new, innovative technology is available at National Headquarters and in three of the National Technical Centers.

Rebecca de la Torre, public affairs specialist, SCS, Davis, Calif.

. . .these two new data bases will increase the efficiency of SCS field personnel working with landowners who want trees as part of their farm management and conservation planning.

Data Base To Include Trees and Windbreaks

ONE OF THE MAJOR technological breakthroughs for the Soil Conservation Service conservation planning effort paired a computer system, the Field Office Communication and Automation System (FOCAS), and a software program — the Computer Assisted Management and Planning System (CAMPS). This combination is doing a wide variety of tasks, from detailed conservation planning to scheduling and filing in field offices. In many SCS field offices, it has changed the way the job is done.

Two new data bases that will operate on existing FOCAS equipment, presently still in the testing stages, will increase the efficiency of SCS field personnel designing conservation plans that include trees. The first data base is Integrated Forest-Soils Management (INFORM); the second is Windbreak Planning and Specifications (WINDSPEC).

One of the main goals of INFORM is to develop a forestry resource management system to aid in conservation planning to comply with the Food Security Act (FSA) of 1985. Forest-soil interpretations have been developed for most States. Currently, each State uses sections of the Field Office Technical Guide to analyze and develop alternatives and specifications for establishing forestry practices. Formerly, this resource information was manually collected from various sources for developing a conservation plan.

With the advent of the INFORM data base, field office personnel will improve the efficiency and consistency of their technical forestry work. INFORM will be an interactive, data base structured for entry, editing, and printing of forest-soil interpretations. Also included is entry and editing of landowner objectives and onsite inventory data. The data base can be linked and matched to produce a practice specification unique to each site that may be printed for the landowner, or filemerged into a progressive conservation plan. The time involved to develop choices for the landowner will be decreased.

WINDSPEC has many of the same features as INFORM. The main difference is that the objective changes from a general forestry data base to one more specific: developing windbreaks as an integral part of a conservation plan. The WINDSPEC data base will also include the development of onsite specifications.

Soil-windbreak interpretations have been developed for most States in the form of windbreak suitability groups. This information aids in constructing specifications unique to farmsteads, feedlots, and field windbreaks used in the Conservation Operations Program, Conservation Reserve Program, and the Great Plains Conservation Program.

Both data bases are designed to be self-contained with no need to access telecommunications. The software uses C' language programming, and will retrieve data from existing and new CAMPS data bases. In each case, alternatives were evaluated before the final data bases were chosen. Both data bases are projected to have substantial cost savings to the agency: $360,000 per year for WINDSPEC, and $540,000 per year for INFORM.

Besides receiving CAMPS manual updates, all field offices having FOCAS equipment will also be slated for additional training in the use of both INFORM and WINDSPEC software. The development of these two new data bases will increase the efficiency of SCS field personnel working with landowners who want trees as part of their farm management and conservation planning.

Kathleen Diehl, contributing editor, SCS, Washington, D.C.

The SCS strategy for GIS technology at all levels of the agency is to make it available as a routine tool for the natural resource manager.

GIS Analyzes Natural Resources

ANALYZING AND MANAGING natural resources is one of the major challenges facing the Soil Conservation Service in the decades ahead. A new technology called Geographic Information Systems (GIS) is rapidly emerging as the dominant information management technology for these purposes. The GIS will input, manage, analyze, evaluate, and display geographic data. GIS supports natural resource decisionmaking not only in using traditional tabular data base management system techniques, but also by using powerful analytical software programs that model space in two or three dimensions.

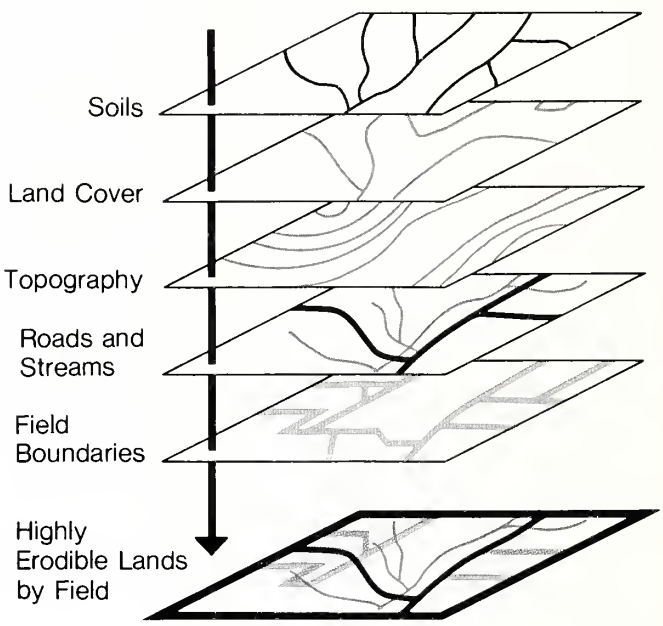
Because the Soil Conservation Service is a major land management agency, the interest in developing and implementing a GIS is a logical and natural outgrowth of that role. In helping land owners, State and local governments, and others manage land and water resources, SCS conservation specialists frequently use geographic information from maps and aerial photography for planning and decisionmaking. Basically, soil and water conservation resource concerns are spatial in nature and involve complex interrelated processes. GIS deals with complex spatial data bases and displays results in a way that makes relationships, trends, changes, and proposed solutions easily understood.

With the advent of the Field Office Communications and Automation System (FOCAS) hardware in many State and field offices, the opportunity to purchase computer hardware to support GIS became available. A careful evaluation and selection of GIS software was coordinated by the Cartography and GIS Division. The GIS software used is called SCS-GRASS (Geographic Resources Analysis Support System). GRASS is a public domain software package originally developed by the U.S. Army Corps of Engineers. Presently, it is maintained and enhanced by a multiagency coordinated effort that includes the Army, SCS, the National Park Service, the U.S. Geological Survey and others.

GRASS was evaluated in a 6-month test in seven State locations to digitize and analyze resource data and plot maps. With positive recommendations and cost-benefit figures from the test teams, SCS made the GRASS software available to State and field offices in the fall of 1988. Approximately 60 offices have received GRASS and are in various stages of implementation and use.

The SCS strategy for GIS technology at all levels of the agency is to make it available as a routine tool for the natural resource manager. Thirteen States presently have full-time GIS specialists. User support such as training, technical assistance, and data base development, reformatting, and maintenance for GIS will come from the National Cartographic Center in Ft. Worth, Tex., and the State offices.

People experienced with GIS have found that GRASS offers better performance with commands easier to apply in solving analysis problems than other comparable software programs. GRASS is presently being interfaced with the Computer Assisted Management and Planning System



Spatial information portraying such themes as soils, land cover, topography, roads, streams, and field boundaries are among those data layers typically used in a Geographic Information System (GIS) to produce interpretive maps and their related tabular data. Through an ANALYSIS function, the GIS creates a map depicting the highly erodible cropland areas.

"With everyone's cooperation and with the help of current technologies . . . Oklahomans can make maximum use of all scenic and natural resources of the region."

(CAMPS), which will require a field office user to have only minimal knowledge of GRASS to be able to generate a conservation plan map or a soil interpretative map.

Robert R. Shaw, deputy chief for technology in Washington, D.C., says GIS is a very important technology which is needed in SCS to support the increasingly complex solutions required in wind and water erosion predictions, to analyze water quality and quantity, and to develop effective conservation planning alternatives. "In spite of the new tools GIS gives to the resource manager," he said, "offices should proceed cautiously with implementation, as GIS is a sophisticated technology. Experienced GIS users are difficult to find and if existing data bases are not available, they are expensive to develop." He added that State offices will be successful in implementing GIS by first preparing a GIS plan, hiring a GIS Specialist, and establishing agreements with other agencies to share in the development and exchange of geographic data.

More information about the availability and characteristics of GRASS software and GIS training can be obtained by calling the GRASS hotline — (817) 334-5580 — at the National Cartographic Center.

George M. Rohaley, National GIS coordinator, SCS, Washington, D.C.

GRASS: New Tool for Water Quality

EVER SINCE THE first farmer kept livestock and planted crops there has always been one constant problem: what to do with animal waste. But, today's farmer has many options for decisionmaking because of new technology.

For example, the Geographic Resources Analysis Support System (GRASS) software gathers information needed to make assessments in problems such as animal waste disposal.

The computerized Oklahoma Geographic Information System (GIS), utilizing SCS-GRASS, is proving to be an effective tool in assembling resource data and making risk assessments in the ongoing Illinois River Basin Study. The Illinois River Basin includes more than 1 million acres of mostly pasture and forestland in northeastern Oklahoma and northwestern Arkansas.

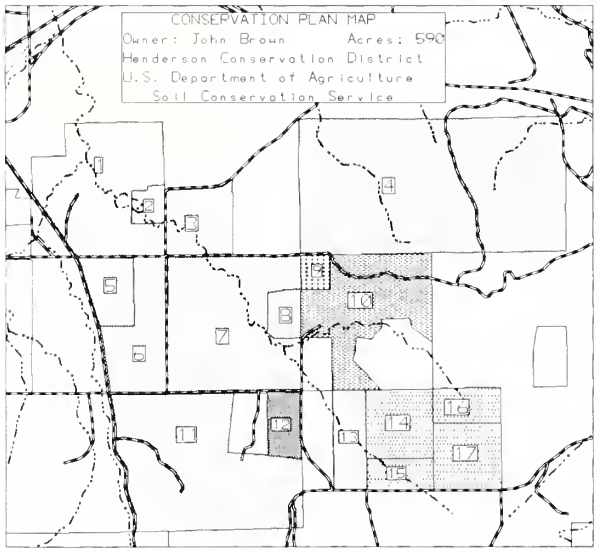
Objectives of the Illinois River Basin Study are to better define and document water quality problems, locate soil areas with a high potential for nutrient loss, fill in data gaps, evaluate best management practices, recommend alternative water quality management systems, and prepare potential risk assessments.

Soil data interpretation is an important feature of the GIS. The shaded areas have a high probability for nitrate leaching below the root zone. The white areas have a medium probability to nitrate leaching. The darkest shaded areas are water bodies.

Using GRASS, SCS staff members have generated:

- Maps and reports for each subwatershed showing the location and population of confined poultry and dairy facilities;
- Estimates of manure volumes produced from these facilities;
- Colored maps and acreage reports of open pastureland and cropland potentially available for animal waste disposal;
- Colored maps showing soil areas with high potential for nitrate leaching below the root zone which help in mak-

Digitized property and field boundaries are displayed on a conservation plan map overlaying land cover, roads, and streams. GRASS displays the same map in color as well as generates reports such as the field acreages.



Tract Number 1111

Field	Acres	Landuse
1	47.2	Cropland
2	11.8	Cropland
3	26.5	Cropland
4	118.0	Cropland
5	23.6	Cropland
6	35.4	Cropland
7	53.8	Cropland
8	17.7	Cropland
9	16.5	Residential
10	47.2	Rangeland
11	63.1	Cropland
12	20.6	Woodland
13	26.6	Cropland
14	26.0	Pastureland
15	15.3	Pastureland
16	15.6	Pastureland
17	25.0	Pastureland
Total	590.0	

ing decisions about manure application rates and nutrient leaching risk assessments; and

• Land use maps of the watershed.

This material is used to locate soil areas that are the most susceptible to nutrient overloading and have a high potential for surface and ground water contamination. The GRASS software will be used in generating other data and spatial maps needed for other phases of the study. Generated maps can be easily displayed on the computer screen and attractive output products, such as colored maps, can be generated on paper or clear mylar.

"The SCS-GRASS software readily performs some of the tasks needed for a study like this," said Darrell Hickman, GIS specialist, SCS State office, Stillwater, Okla. "GRASS is a very useful tool for data storage, data manipulation or overlay, and preparation of analyses or reports."

According to Hickman, the data layers used in the Illinois Basin data set are soil survey data, land use information, and the location of confined poultry and livestock facilities by numbers of birds or dairy animals. In addition, subwatershed boundaries are stored for the five major subwatersheds in the Oklahoma part of the Illinois Basin. Existing water well test data and well locations are expected to become a part of the data set soon.

The Illinois River Basin has a high potential for beef cattle production. However, one limiting factor is the low fertility level of the grazing lands. Much of the fertility needs for high-level grass production could come from poultry and animal manure produced in the area. It has been estimated that manure from the poultry industry in the Illinois Basin alone produces 11,000 tons of nitrogen and 5,200 tons of phosphorus annually. The plant nutrients available in produced manure byproducts are a valuable fertilizer resouce if handled and applied properly. If improperly managed, this nutrient resource, combined with other nutrient sources in the basin, will potentially become a major water quality problem to the entire region.

According to Charles Thomas, water resources planning coordinator, SCS, Stillwater, Okla., "With everyone's cooperation and with the help of current technologies, such as the GIS system and installation of best management practices for water quality, the Illinois River Basin's ground and surface waters can be protected from pollution. This means that Oklahomans can make maximum use of all scenic and natural resources of the region."

Billy J. Wagner, State soil scientist and GIS coordinator, SCS, Stillwater, Okla.

"This jump in technology is like going from a tin can and string to satellite communication."

Remote Sensing Sees the Big Picture

THE TECHNOLOGY of remote sensing — seeing without actually being there — is aiding the Soil Conservation Service to manage natural resources. It can take the form of aerial photography, or it can be pictures and data sent from satellites and processed by computers.

"This jump in technology is like going from a tin can and string to satellite communication," said Joanne Vogel, geographic information systems specialist for SCS in the New Jersey State office. "We sit at a computer terminal and see a satellite picture of a large part of the State at one time, in good detail, and then overlay maps of soils and topography on that picture, and look at tables of soil characteristics and other data. We can then use all this information to inventory and assess our natural resources — that's actually our goal."

A joint Federal/university/private industry venture is making this and other exciting uses of remote sensing data possible. Four years ago, the Remote Sensing Center started at Rutgers University Cook College, New Brunswick, N.J., in a converted chicken coop. The Center began with seed money from the SCS Resources Inventory Division and the New Jersey Agricultural Experiment Station. The initial project was to investigate ways to get data for

The new $10.7 million high-tech facility (top) will house the Cook College Remote Sensing Center. Joanne Vogel, geographic information systems specialist for SCS in the New Jersey State office (left), and Barbara J. Dibeler, a graduate student working on a GIS project, stand in front of the old center, a converted chicken coop (bottom). (Photos by **Linda Feldman.**)

SCS's National Resources Inventory (NRI) by remote sensing, rather than sending people out in the field to collect data. SCS is committed to developing ways to reduce the amount of time and effort that goes into producing a national resource inventory.

In September 1989, 4 years later, the Cook College Remote Sensing Center

The goal of this course is to increase the knowledge, skills, and abilities of field personnel in the use of basic remote sensing techniques.

(CCRSC) moved from the chicken coop to a $10.7 million high-tech facility. The building has dedicated space for all equipment including about $750,000 in computer equipment contributed by AT&T, a state-of-the-art teaching facility, and private offices. The CCRSC is directed by Department of Environmental Resources chairman Teuvo Airola. The Department of Environmental Resources is merging with the Departments of Forestry and Wildlife to greatly expand research efforts including remote sensing.

The CCRSC currently buys and analyzes data from two satellites: the Landsat Thematic Mapper and a French satellite called SPOT. This data is analyzed on computers called image processing systems.

"With the data," Vogel explained, "we can produce land-use maps at any desired scale. Satellite data is very current data and can provide information that is not visible in aerial photographs. It is stored in digital format and so can be readily enhanced and analyzed by computer.

"Also, since the data is already in a computer format, we can merge it with another computer system that SCS uses to model the environment, called GIS — Geographic Information System." SCS uses GIS to manage and analyze natural resource data that is in spatial form — such as soil, land use, and topography maps.

The future uses of merging GIS with remote sensing are unlimited. The maps that can be produced from image processing systems and modeled with GIS reveal many kinds of information: what crops are being grown, how much farmland is being lost to urban development, information on wildlife habitat, conservation planning for farms, the factors that affect water quality, wetland maps, and locations of highly erodible land. Remote sensing and GIS can also be used to help automate updating of soil maps for soil surveys.

"Remote sensing is the technology of the future," said Tom George, director of the SCS Resources Inventory Division in Washington, D.C. "We will be highly dependent on the work of several remote sensing centers such as the one in New Jersey for the National Resources Inventory in 1997 and 2002." (See accompanying article on NRI.)

Linda Feldman, public affairs specialist, SCS, Somerset, N.J.

SCS Offers Course on Photo Interpretation

WANTED: SCS EMPLOYEES who want to improve their efficiencies in conservation planning, resource inventories, and mapping. . . .

A remote sensing/photo interpretation course will be offered by the Soil Conservation Service, providing participants maximum exposure and hands-on activities in aerial photo interpretation. The course, which started out as a pilot project in Minnesota and West Virginia, will be taught in 1-week sessions in Reno, Nev.; Ft. Worth, Tex.; and Gaithersburg, Md.

The goal of this course is to increase the knowledge, skills, and abilities of field personnel in the use of basic remote sensing techniques. Each State will choose a few trainers to attend the course who, in return, will provide the appropriate training to other field personnel who need to develop photo interpretation skills.

Requirements for trainers are good depth perception, full-color vision, good communication skills, teaching skills, field experience, and multiprogram and multidiscipline experience.

The Photo Interpretation and Instructional Guides for this course are very extensive and composed of narrative sections and aerial pictures. Topics covered in the guides include aerial photography characteristics, direction and scale, maps and map projections, earth cover types, and land and water uses, and also, most importantly, the application of photo interpretation. The guides were prepared by Remote Sensing Specialists Michael E. Rasher and Wayne Weaver.

SCS employees who are interested in becoming trainers in their States should contact Richard Folsche, director, National Cartographic Center, Ft. Worth, Tex. Telephone: (817) 334-5253.

Lillyvette M. Montalvo, public affairs specialist intern, SCS, Washington, D.C.

The software provides information to assist individual producers in examining their options.

Software Aids "Whole Farm" Planning

AGRICULTURE HAS COME a long way since our grandfathers' time. Back then, agricultural methods and techniques were something that had been passed from generation to generation mostly through oral history and experience. The U.S. Department of Agriculture came into the picture in the form of direct assistance through the Extension Service, offering information on technological advances, farm management techniques, and other aids to help grow crops more profitably. Later, the Soil Conservation Service emphasized conservation practices for particular enterprise systems and assistance in preserving long-term productivity by better resource management.

The difficulty for these early farmers and those who followed them was when the farm plan that was the most profitable was not the one that met conservation objectives. Both agencies were charged with different objectives and farmers and landowners, in general, were not always given the total range of effects on their operation.

That was before the Farm Level Economic and Conservation System (FLECS). This is a spreadsheet-based, computer analysis tool designed to provide farmers, working with trained conservationists, the means for compiling "whole farm" conservation plans. The software provides information to assist individual producers in examining their options. This is accomplished by making comparisons of present and proposed alternative plans across a number of important concerns including profitability, cash flow, and effects on soil erosion. Plans are evaluated by adjusting and fine tuning equipment, tillage, and management inputs on a field-by-field basis.

The FLECS system uses data supplied by agents and farmers, as well as default values and a series of prespecified formulas and relationships. This includes a description of farm operations, available equipment, field and erosion conditions, number of acres in each field, crop rotation information, and tillage practices used.

The output of FLECS is a whole farm analysis comparing overall profitability of a present and a proposed plan. It also provides a summary of operating costs, revenues, and erosion compliance for each field. This analysis may be important to farm operators in the next 5 years as they undertake to schedule and implement Food Security Act compliance plans.

FLECS uses the LOTUS 1-2-3 spreadsheet program. It is menu-driven and easily operated by individuals having a cursory knowledge of spreadsheet programs. Copies of FLECS may be obtained from Dr. Bart Eleveld, OSU Extension Farm Management Specialist, OSU Extension Service, Ballard Extension Hall, Oregon State University, Corvallis, OR 97331.

Michael Taylor, Ph.D. candidate, Oregon State University, Corvallis, Oreg., and **Dr. Howard Thomas,** economist, West National Technical Center, Portland, Oreg.

SCS, a leader in the application of GPR technology, has four units that it uses to improve the quality of its soil surveys. . .

Radar Leaves Graves In Peace

SCS District Conservationist Jim Monahan of the St. Albans, Vt., field office helps obtain readings from a ground-penetrating radar unit being pulled across the site of a Native American burial ground along the Mississquoi River. (Photo by **David Goss.**)

USING GROUND-PENETRATING radar (GPR), employees of the Soil Conservation Service have confirmed the extent of a Native American burial ground on the banks of the Mississquoi River in northern Vermont. The State now plans to purchase the site and protect it.

GPR works by sending electromagnetic waves into the ground. By the way they are reflected, these waves can indicate anomalies or subsurface features different from the surrounding soil material. As a portable GPR unit is pulled across the ground, its findings are recorded on graph paper. The equipment is most sensitive within a depth of about 10 feet and in dry, sandy soils.

SCS, a leader in the application of GPR technology, has four units that it uses to improve the quality of its soil surveys and to locate bedrock, voids, and sinkholes at potential construction sites. The agency has also used its GPR units to help locate archaeological relicts without disturbing them.

The Vermont site containing the burial ground, on the outskirts of the community of Highgate, was purchased by the Vermont Nature Conservancy from a developer who had been denied a permit to build on the land.

SCS was then asked to suggest ways to stabilize the severely eroding river bank to protect the burial ground.

"It was a really steep bank," said Gregg Schellentrager, assistant State soil scientist for SCS in Vermont, who coordinated the GPR survey of the 2-acre site. "The Nature Conservancy knew there were graves in the area, but wanted to know if the bank could be sloped back without damaging them. Our GPR investigation indicated that this could not be done, so we are developing an alternative plan. This plan involves the placement of gabions to protect the bank and possibly a retaining wall at the base of the slopes to prevent further erosion."

The burial ground is thought to have been used by the Abenaki Indians up to about the year 1600. Once it obtains adequate funding, the State Division of Historic Preservation plans to buy the land and protect it not only from erosion but also from looters who have been in the area looking for artifacts.

Homer St. Francis, current chief of the Abenakis, was on hand for the GPR survey and said he was opposed to any excavation. "They should rest in peace," he said.

Schellentrager said this was not the first time SCS has used GPR in a search for human remains. A GPR unit was used in Alabama to locate a Confederate cemetery and in Florida to search for the body of a murder victim.

"You can't actually 'see' a body with the GPR," Schellentrager said. "You do, however, see something that is different from the surrounding soil material and may be worth investigating."

Paul Barker, associate editor, SCS, Washington, D.C.

"It is important for people to be able to identify the plants they find in crop or grazing fields . . . to identify noxious weeds because they can spread fast."

Volunteer Photographs Plants

Earth Team volunteer Judy Hilty steadies a plant before she photographs it for a photographic herbarium for the Upper Arkansas Soil Conservation District of Colorado. (Photo by **John Nelson.**)

WHEN A LANDOWNER walks into a Soil Conservation Service office with a wilting leaf, asking what it is and what should be done about the infestation in his field, how can SCS help him?

In the Upper Arkansas Soil Conservation District of Colorado, which includes Lake and Chafee Counties, someone from the SCS Salida office hands the landowner a mounted and photographed species sample that comes complete with the name of the plant, information about it, and techniques for getting rid of it.

The reason this district is so efficient with handouts is Earth Team volunteer Judy Hilty from Maysville, Colo. Hilty has been working as a volunteer since July 1988 and has photographed almost 400 different plants in the district and has mounted 100 others.

One of the most widespread noxious weeds in the district is the leafy spurge. Because of the photographic documentation and the handouts provided by the district and USDA's SCS and Extension Service, farmers have the knowledge they need to deal with the weed and to destroy it immediately when it spreads to their land.

"It is important for people to be able to identify the plants they find in crop or grazing fields," said Hilty. "It is especially important for farmers and ranchers to be able to identify noxious weeds because they can spread fast."

Colored slides are kept for reference, and Hilty is putting together a photographic herbarium for the district. She has collected samples and photographs of both native and introduced plants. Using reference books, she identifies and labels the pressed plants and mounts them in a notebook at the Salida office. Her next project involves cataloging, in the SCS computer system, all the plant varieties she has identified. The ultimate goal of the project is to be able to look at the plants the landowners bring in and almost immediately give them an informational handout directly from the computer.

Hilty learned about plants while earning a master's degree in horticulture from New Mexico State University. While she didn't know much about conservation, she has learned quite a lot from her volunteer work.

Hilty is also working on experimental plantings of shrubs on mine tailings, the inferior or refuse material separated as residue in processing. The pH of mine tailings is from 2 to 5 — very acid. Over 200 varieties of shrubs have been planted and Hilty has photographically documented the progress of the plants.

"I am learning a lot of conservation concepts," Hilty said. "Another interesting job I helped with was seeding trials in the Ute Trail area — we are looking for plants that will help prevent erosion."

Hilty was awarded State runner-up among Earth Team volunteers in 1988 for her photographic and classification efforts.

Jerry Schwien, public affairs specialist, SCS, Denver, Colo. and **Tracy Harmon,** staff writer, *Mountain Mail*, Salida, Colo.

NEWS Briefs

Watershed Education Program Begins

THE CHESAPEAKE BAY Foundation, along with the Virginia Division of Soil and Water Conservation, is offering a watershed education program for 7th to 12th grade students, focusing on how agricultural practices and land use management have a direct impact on the Chesapeake Bay and its tributaries.

With the support of the Chesapeake Bay Initiatives and the Virginia Department of Conservation and Historic Resources, the program will allow participating students to discover firsthand how the management of local farms and nearby creeks and streams affects water quality in the Bay.

The watershed education program brings a new perspective to Virginia's students, especially those from the more rural and western parts of the State. The program highlights the use of agricultural best management practices (BMPs), soil and nutrient runoff, water quality testing, and a farm's connection to the Bay.

Thus far, 25 trips have been held, involving 550 students from 10 counties.

Lillyvette M. Montalvo, public affairs specialist intern, SCS, Washington, D.C.

Radio First With Farmers

ON MANY FARMS, the first sound heard is not the traditional rooster heralding in a new day. Even before the rooster is awake, farmers are tuned in to an agricultural marketing report or the weather report on the radio. Most farmers today can't remember a time where there wasn't a radio with farm reports, and they consider the farm broadcaster to be almost a personal friend.

This is one of the many findings revealed in a recent survey conducted for the National Association of Farm Broadcasters. The main finding of the survey was that 98 percent of farmers' first choice for information about agriculture is radio.

Half the farmers surveyed paid closest attention to the radio between 12 noon and 1:00 p.m and more listen during the summer months than winter. Seventy-nine percent of farmers listen to the radio daily for weather reports and 61 percent listen for market reports. Most farmers surveyed have at least three radios, including the one in the truck, and some own up to seven radios.

The survey was conducted by the Doane Marketing Research Company. For further information contact, Roger Olson, executive director, National Association of Farm Broadcasters, 26 E. Exchange Street, St. Paul, MN 55101.

Thirty Million Acres and Counting

AN ADDITIONAL 2.5 million acres was enrolled in the 10-year Conservation Reserve Program (CRP) during the eighth signup held February 6-24, 1989.

The total acreage now contracted under CRP is 30.6 million acres, according to USDA's Agricultural Stabilization and Conservation Service. CRP has becomes the largest long-term cropland retirement program in U.S. history, exceeding the 28.7 million acres that was in the Soil Bank Program in 1960.

The recently expanded eligibility criteria that allows cropped wetlands into the program resulted in the enrollment of 155,961 acres this signup. Suitable cropped wetland acres will be planted with trees; this new tree cover feature has helped increase the CRP tree-planting rate from 6.2 percent during prior signups to 8.3 percent, or 203,703 tree acres, for this signup.

USDA has also recently implemented scour erosion eligibility criteria that allow certain fields that suffer from flood erosion to qualify for CRP; 63,631 acres were enrolled in CRP during the latest signup. The next CRP signup was scheduled during July and August.

NEW in Print

Soil Morphology, Genesis, and Classification

by Delvin S. Fanning and Mary C. B. Fanning

This book is intended as a textbook for an advanced undergraduate course in soil morphology, genesis, and classification as well as a reference book on these topics. Certain sections are devoted to "horizon nomenclature by the ABC system and to the diagnostic epipedons, horizons, pans, and other soil profile or pedon features of Soil Taxonomy, which are all based on soil morphology." The text stresses soil morphology in order to emphasize that "most efforts to understand the genesis of, and to classify, given soils must begin with their morphology." Sections on soil genesis are concerned with the processes of soil formation known as the "factors" of soil formation, as promulgated by the writings of Hans Jenny.

This hardcopy text is available from John Wiley & Sons, Inc., 1 Wiley Drive, Somerset, NJ 08875-1272. The cost is $54.95.

Engineering Hydrology Techniques In Practice

by Elizabeth M. Shaw

The impetus for this collection of 65 case studies on engineering hydrology was generated by the author's earlier text, Hydrology in Practice, published in 1983 by Van Nostrand Reinhold (UK). The new text provides more examples of hydrological techniques than the earlier work. It is essentially divided into two broad categories of hydrological problems: those involving a surplus of water and therefore requiring drainage schemes, and those in which the need for water resources is paramount. The book begins with a chapter on hydrometric schemes. The final chapter provides examples of recent operational and management studies.

This hardcopy text is available from John Wiley & Sons, Inc., 1 Wiley Drive, Somerset, NJ 08875-1272, at a cost of $98.

Windbreak Technology

Edited by J. R. Brandle, D. L. Hintz, and J. W. Sturrock

This collection of papers on state-of-the-art wind technology is derived from the first International Symposium on Windbreak Technology. Authors of these articles are researchers, natural resource managers, and specialists from a variety of disciplines. Each is recognized as being an authority in windbreak technology. This text is a valuable reference for those individuals who are involved with directing or planning wind erosion control systems and windbreak activities.

Individual chapters deal with the following:

- the effects of windbreaks on turbulent transport and microclimates, the structure of wind flow, and plant responses to wind;
- wind erosion, including basic wind erosion processes, the basic principles of wind erosion control, and design and use of field windbreaks in wind erosion control systems;
- nonwood windbreaks and crop response to windbreaks;
- livestock and windbreaks;
- windbreaks and energy (including the topics of farmstead windbreaks and using windbreaks for home energy conservation);
- windbreaks and wildlife;
- windbreaks concerning snow and water use, and windbreak planting and establishment; and
- windbreak management, including such diverse areas as disease and insect management and agroforestry in windbreaks.

Hardback copies of the publication are available for $221 from the Journal Information Center, Elsevier Science Publishers, P.O. Box 1663, Grand Central Station, New York, NY 10163.

New Publications Of the U.S. Geological Survey

Department of the Interior, U.S. Geological Survey

This monthly periodical lists new publications issued by the U.S. Geological Survey. Listings include various books, professional papers, open file reports, circulars, and general interest publications, many of which are relevant to the field of soil and water conservation. Hydrogeology in numerous States, ground water pollution, methods of hydrology, general water pollution, and sea water geochemistry are among the various topics covered.

This softcover publication is available without charge from the Branch of Data Systems, Mailing List, 582 National Center, Reston, VA 22092.

New in Print is prepared by **Thomas J. Kergel,** editorial assistant, SCS, Washington, D.C.

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Conservation Calendar

September	4-8	The 119th Annual Meeting of American Fisheries Society, Anchorage, Alaska
	6-8	National Association of Conservation Districts Southwest Region Meeting, Longmont, Colo.
	9-13	International Association of Fish and Wildlife Agencies, Pierre, S. Dak.
	12-15	National Association of Conservation Districts Pacific Region Meeting, Kona, Hawaii
	12-15	Radio & Television News Directors Assn. Int'l Conference & Exhibit, Kansas City, Mo.
	17-22	American Water Resources Association Conference & Symposium, Tampa, Fla.
	19-20	American Veterinary Medical Association Symposium, Washington, D.C.
	20-22	National Waterways Conference, Inc., Annual Meeting, St. Louis, Mo.
	21-24	American Meat Institute Convention and Exposition, Chicago, Ill.
	24-27	National Convention of the Society of American Foresters, Spokane, Wash.
	27	Entomological Society of America Meeting, Washington, D.C.
	28-30	National Hay Association Convention, S. Padre Island, Tex.
October	4-8	World Dairy Expo, Madison, Wis.
	11-13	International Agribusiness Forum, Bellevue, Wash.
	12-13	Practical Conference on Communication, Oak Ridge, Tenn.
	22-24	American Feed Industry Association Midwest Convention, Kansas City, Mo.
	22-25	Communication Officers of State Depts. of Agriculture Annual Meeting and Workshops, Atlantic City, N.J.
	29-Nov. 1	Southern Agricultural Association Convention, Pine Mountain, Ga.
November	3-4	American Agricultural Law Association Annual Meeting & Educational Conference, San Francisco, Calif.
	9-11	62nd National Future Farmers of America Convention, Kansas City, Mo.
	9-11	National Association of Farm Broadcasters Annual Meeting, Kansas City, Mo.
	10	Nebraska Hall of Agricultural Achievement Award Ceremony, Lincoln, Nebr.
	12-15	1989 International Irrigation Exposition & Technical Conference, Anaheim, Calif.
	14-18	Natural Resources for the 21st Century Conference, Arlington, Va.
	28-30	66th Annual USDA Outlook Conference, Washington, D.C.